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Gender and Racial Training Gaps in Oregon Apprenticeship Programs

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Abstract

This paper uses micro data from Oregon to measure the gender and minority training gaps in apprenticeship training. Its methodological innovation is the use of on-the-job training credit hours of exiting workers as the measure of the quantity of training. Apprentices who started training between 1991 and 2002 are followed through 2007. Controlling for individual and program attributes, women and racial/ethnic minorities on average receive less training than men and whites, respectively. Union programs deliver more training than nonunion programs, regardless of gender and race/ethnicity. Prior education level has a strong impact on training, especially for women and minorities. The evidence does not support the hypothesis that apprentices who quit are sufficiently qualified to be able to obtain high-skill jobs.

Keywords: Training, Gender, Race, Unions

JEL Classification: J15, J24, J51

Disclaimer: The opinions, analysis, and conclusions of this paper are solely the authors' and do not necessarily reflect those of the State of Oregon Bureau of Labor and Industries.

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1. Introduction

Between 1991 and 2007, some 50,000 new workers joined the apprenticeship workforce in the state of Oregon, U.S. They were distributed across 132 occupations in all major industries. Women made up six percent of all new registrations, and ethnic/racial minorities (henceforth minorities) 14 percent. The percentages of women and minorities who completed training lagged behind men and whites, respectively. These outcomes by gender and race/ethnicity are broadly similar to the observations of the previous studies on the U.S. apprenticeship programs. However, the determinants of the quantity of apprenticeship training hitherto have been addressed only through proxies, while the newly available Oregon database provides direct measures of the quantity of training at the time of exit from the apprenticeship program. This permits a more direct examination of training quantity, and makes it possible to assess definitively whether the apprentices who quit receive sufficient training to reasonably be expected to get high-skill jobs.

Employment in the trades workforce requires an endowment of the necessary occupational skills, and apprenticeship is the traditional route to acquire these skills. Workers are attracted to apprenticeship because it is a remunerated alternative to college en route to building a career with high wages and perhaps starting a business. The lack of access to training would explain in large part why non-traditional workers – women and minorities – are historically under-represented in the crafts. The barriers are present both at the point of entry into and during apprenticeship. In this paper we focus on the second stage of the process and compare the male-female and white-minority gaps in the quantity of training, as measured by the number of on-the-job-credit hours accumulated by the apprentices, and examine the determinants of these gaps.

2. Determinants of the Quantity of Training

Formal apprenticeship in the U.S. combines on-the-job training (OJT) and in-class related theoretical instruction (RTI) to provide general training in an occupation. Apprenticeship programs have predetermined hours of OJT (typically ranging from 2,000 to 10,000 hours), and RTI (144 to 720 clock hours). Upon completion, the apprentice receives certification that recognizes him or her nationwide as a journey worker in the trade. Apprenticeship programs in the U.S. are sponsored either jointly by unions and signatory employers, or unilaterally by employers (henceforth union and nonunion programs). The costs of administration of training are borne by employers in non-union programs and are shared by employers and unions (generally through a training trust) in the union-management jointly sponsored programs. Apprentices also bear a portion of the training costs by working for training wages, which start at a fraction of the journey-level wage and rise over the course of training. In addition, apprentices may pay for tuition and books, either out of pocket or through a scholarship loan agreement. Apprentices can quit the program without penalty.

According to the neoclassical economic theory, the worker pays for general training and the quantity of training depends positively on the private value of training net of costs (Altonji and Spletzer 1991). This proposition means that an apprentice will continue acquiring skills as long as the sum of expected discounted present values of two earnings streams – apprenticeship earnings up to the completion of the program and the subsequent lifetime certified journey-level worker earnings – exceeds the expected discounted present value of lifetime income that would be generated if he/she were to quit at that point in time (Malcomson, Maw and McCormick 2003). Thus, factors that influence the expected income streams of alternative career paths determine the quantity of training. These factors include the worker's pre-existing skills, knowledge, and aptitude, job characteristics, availability and remuneration of work in and

outside apprenticeship, the effectiveness of the training programs in delivering skills, expected utilization of acquired job skills, licensing requirements, journey worker certification premium, and the discount rate. The effects of these factors on alternative income streams are often theoretically ambiguous and therefore remain empirical questions.

Three distinct outcomes are pertinent to the determination of quantity of training: (i) quitting due to dissatisfaction with the training or occupation; (ii) quitting because sufficient skills are acquired and additional skills do not justify the costs; and (iii) completion of apprenticeship and receiving journey-worker certification¹.

Case (i):

Apprentices are required to obtain training jobs in order to accumulate skills and credit. The cost of training increases if the pace of skill acquisition is slower than expected either due to the labor market conditions or the quality of the training program. In combination with low apprentice wages (relative to the wage in the alternative line of work), these conditions are likely to induce early quits from the program. An apprentice may also quit early if he/she finds the occupation or the training program disagreeable for any other reason. High start up costs, including tools, transportation, clothing, initiation fees, and, where applicable, union dues, also constitute obstacles to getting a foothold in the training program. RTI, which is on the worker's own time, may be too high a cost for a beginning apprentice.

Case (ii):

Even when there is access to training jobs and the apprentice is satisfied with the program/occupation, the apprentice may still quit training prior to completion once the "optimal" skill stock is accumulated. Three wages are going to be relevant to the apprentice's decision: the

¹ There is also the possibility of the program terminating the training agreement because the apprentice doesn't satisfy the program requirements. This is conceptually the same as the quits in case (i).

training wage, the “outside” wage (what the apprentice can earn in the trade after dropping out), and the certified journey-level wage. The training wage is predetermined by the program as a percentage of the journey-level wage, and rises as the apprentice progresses. The outside wage varies directly with the skills acquired in apprenticeship. The apprentice would quit training before the completion of the program if, given the journey-level wage, the outside-training wage gap rises sufficiently in favor of the former so that the expected lifetime income in the outside career dominates the apprentice plus journey worker income streams. In neoclassical terms this quit is an optimal separation. In addition, loose licensing requirements or the option of attaining a lesser license without completing the program (e.g., getting a low-voltage electrical license after quitting a general inside electrician training program) would also raise the likelihood of this kind of quit. This case recognizes that the optimal quantity of skills may not be the maximum amount required by the program sponsor, an outcome emphasized by economists who warn about the “sheepskin” effects and some apprenticeship program sponsors who argue that high quit rates do not mean lackluster program performance.

Case (iii)

When the expected discounted value of the lifetime outside income falls short of apprenticeship cum journey worker income stream, training would continue until the program is completed. The likelihood to complete apprenticeship is expected to increase with the journey level wage relative to the outside wage. The escalating apprenticeship wage schedule over the training period also offsets, at least in part, the pressure to quit. Union workers who seek to qualify for union wages and benefits, and nonunion workers who need to signal quality in a labor market characterized by asymmetric information are also more likely to complete training and receive certification.

Among the factors that determine the expected present value of training, the literature emphasizes the pre-existing levels of basic and job-specific skills (e.g. Altonji and Spletzer 1991; Lynch 1992; Lillard and Tan, 1992; Barron, Black and Loewenstein 1993; Barron, Berger, and Black 1997). Much of the empirical evidence indicates that there is a positive relationship between the pre-existing skills (usually proxied by education level) and the quantity of training on grounds that these are either complementary or are jointly influenced by other factors, such as aptitude or job characteristics. In the case of apprenticeship, it is plausible that a higher level of pre-existing basic skills would improve access to training jobs and therefore positively affect the quantity of training. A good high-school education would also keep apprentices on track by helping in the RTI, which has a heavy math component for most trades. However, the relationship between prior skills and the quantity of training is not necessarily linear because they may become substitutable at sufficiently high levels of pre-existing basic skills (Altonji and Spletzer, 1991). Following this line of reasoning, an interesting possibility is that a combination of a high level of pre-existing skills coupled with sufficient amount of training can lead to high outside wages and quits from apprenticeship prior to completion. In such a case, the preexisting skills-training profile would have an inverted-U shape.

Neoclassical economic theory also suggests that the quantity of training would decline with age because lifetime returns to training are higher for the younger workers. However, to the extent that age serves as a proxy for life and labor market experience, prior skills, and commitment to the labor force, it is likely for the quantity of training to rise with age over a range. Therefore, the age-training profile, again, would have an inverted-U shape. Green (1991) argues that this profile would be pronounced for women because employers are less likely to

offer training to younger women based on the expectation that their labor force attachment is weak.

Institutional factors influence the quantity of training both directly via the organization of training suppliers and indirectly by conditioning workers' demand for training. Training programs are expected to yield greater accumulation of skills to the extent that they do a better job of matching the prospective apprentices with occupations, are more effective in organizing RTI and providing training jobs, pay better wages, and provide a higher overall quality of training. Institutional factors may include union involvement in managing the program, adequacy of the funding mechanism to support training, the number of participating employers, and whether the program is able to sustain its own training facilities.

In union programs, the apprenticeship committee is composed of the representatives of the employers and workers, whereas there is generally no worker representation in unilateral programs. Previous comparisons of union and nonunion apprenticeship programs found that the retention rate in union programs is substantially higher (Bilginsoy, 2003; 2007). This could be attributed to a host of factors, including mandatory participation of signatory employers, multi-employer cooperation, entrenched tradition of apprenticeship and mentoring in the unionized trades, more strict observation of jurisdictional boundaries, union grievance procedures, and unions acting on behalf of the apprentice. These factors ensure stable funding of the training programs and prevent exploitation of apprentices as cheap labor. Unions are more likely to provide better job rotation because they work apprentices on both private and prevailing-wage jobs, while the non-union contractors use apprentices more often on prevailing-wage jobs and rely heavily on helpers otherwise. Some union training trusts use scholarship loan agreements that require the apprentice to pay back the cost of training unless they work a certain number of

years for a participating contractor after program completion (with the loans forgiven after journey-level work begins). The higher retention rate in union programs can also be explained by the fact that union workers have higher incentives to complete the program in order to qualify for union wages and benefits, and be dispatched as a journey worker, which requires either program completion or other formal union recognition of journey status.

A training gap against women is consistently observed in the literature. Neoclassical economic theory attributes the gender gap in training to women's preferences for taking care of household tasks, which arguably create a weaker attachment to labor force and commitment to long-term training. With the expectation that they will be working less than men and therefore reaping smaller returns to investment in training, they are not likely to engage in as much training. By contrast, the poor showing that has historically been observed for minorities is attributed to the discriminatory tastes of the white union workers. The corollary to this argument is that there would be no forces to hinder minority workers from entering the trades in a competitive labor market.

While they are discounted by the neoclassical theory in favor of subjective preferences, historical and institutional factors play a very important role in the shortage of women and minorities in training programs. The trades workforce has been historically dominated by men of European ancestry with strong local networks. One program administrator characterized the trades workforce as the "FBI" (Friends, Brothers, and In-laws) (Oregon Consortium, 1996: 171), which excluded outsiders from these well-paying careers. Since entry into the trades requires substantial front-loaded training, the control of the training programs, often by the trade unions, has been an effective device for exclusion of women and minorities.²

² See, for instance, Marshall and Briggs (1967) on the exclusion of Blacks.

In recent decades, however, many unions have acted as vehicles of integration for minority workers, resulting from the push of the Civil Rights Act, affirmative action policies and the pull of needing to adapt to the changing ethnic composition of the labor force.³ As a result the barriers that minorities faced largely have been removed (particularly in the trowel trades). Government agencies also made an initial push in the late 1970s to increase women's participation in the trades, but there has been minimal government support since then, as affirmative action programs have been reduced to equal opportunity pledges. The result has been a marginal level of integration of women that has not been sufficient to achieve a status for tradeswomen beyond being a "wedge in the door" (Berik and Bilginsoy, 2006).

Nonetheless, problems persist even for those non-traditional workers who successfully navigate entry into a training program. An Oregon survey conducted in 1996, for instance, documents the refrains of nontraditional apprentices who endure shortage of meaningful work assignments and condescending or patronizing behavior on the job, which slow their progress or stop it altogether (Oregon Consortium, 1996). These problems, which have been documented more frequently for white and minority women than for minority men, are part and parcel of the ossified male culture of the crafts, which has created a work environment that is more hostile for women than for minority men. The 1996 Oregon survey records that sexual harassment, physical and emotional stereotyping, discrimination in job rotation, lack of sanitary facilities, and accusations of reverse discrimination are rampant. Such conditions undoubtedly make the integration of women into apprenticeship an ongoing challenge. Finally, the lack of a critical mass of women in the trades to provide mentoring and other kinds of support mechanisms have also limited larger numbers of women from participating in apprenticeship training and entering

³ Several studies have shown that women and minority workers now are better represented in the union apprenticeship programs than their non-union counterparts, suggesting a shift in union practices (Berik and Bilginsoy, 2000; 2002; 2006).

the journey-level workforce. These findings are not unique to Oregon as they are experienced by tradeswomen across the U.S. (e.g. Eisenberg, 1998; Paap, 2006).

3. Empirical Model

The structure of the Oregon apprenticeship database is similar to that of the other databases in the US.⁴ It has an entry for each new registration, which records the dates of entry into and exit from the program, the mode of exit (e.g. completion, cancellation, transfer to another program⁵), and a set of individual and program level attributes.⁶ The status of apprentices who are still in training as of the last date data are compiled is reported as “active.” Two additional pieces of information that the Oregon database provides, hitherto unavailable, are the OJT credit accumulated by each apprentice who quit and the last term observed for each apprentice.⁷ We will make use of these two pieces of information to measure the training gaps.

Previous studies of apprenticeship measured the quantity of training either in terms of a binary variable indicating whether the apprentices completed training or quit (Berik and Bilginsoy, 2000; 2006), or the spell between the entry and exit dates conditional on the type of exit (Bilginsoy, 2003; 2007). The Oregon data for the first time permit measuring the quantity of training directly as the actual number of OJT hours of credit the apprentice accumulated during training. While this is an improvement over previous proxies, it still has drawbacks. First, apprenticeship requirements include both OJT and RTI. Lacking of RTI data, we are forced to ignore in-class instruction and therefore fail to capture this dimension of apprenticeship training. Secondly, our measurement of training assumes that the training hours are homogenous, i.e. an

⁴ The latter are the AIMS and RAIS of the U.S. Department of Labor, and the California Apprenticeship Agency Database (Bilginsoy, 2005).

⁵ In this paper we use the terms “cancellation,” “termination,” and “quitting” interchangeably.

⁶ Each registration does not necessarily refer to a unique apprentice because the same worker can register in different programs at different times. We are interested in the outcome of each registration and therefore use it as the unit of observation. Thus, in the following empirical work “apprentice” refers not to a unique individual but to a registration.

⁷ Each apprentice program is divided into terms or periods of equal length in hours of training.

hour of training yields the same amount of skills at any point during apprenticeship. Strictly speaking, this is not accurate. The first phase of training, corresponding to around 1,000 hours in a 8,000 hour program for instance, is usually the probationary period during which the apprentices are assigned more menial tasks and probably learn fewer skills than any other period of equal length. This source of non-homogeneity is time-specific and requires care in interpretation of results for workers who quit early. It is also conceivable that the training sponsor may schedule provisioning of skills strategically, e.g. saving the most valuable ones until the end of the training in order to raise retention. This is not very likely in practice (at least in construction, where most of the apprentices are) because the sequencing of the skill acquisition is often dictated by the availability of the training jobs. Thus, our assumption of the uniformity of training hours is admittedly an approximation but not entirely unreasonable.

In this paper we chose programs with 8,000-hour OJT requirement, which is the modal program length. Since the hours of training are bounded, we express the quantity of training as the percentage of the maximum 8,000 hours. Letting q stand for the hours of training acquired by an apprentice, the linear model to estimate the fraction of training completed by apprentice i registered in program-occupation j is:

$$(1) \quad q_{ij} / 8000 = \alpha + \sum_i X_i \beta_i + \sum_j Z_j \gamma_j + \varepsilon_{ij},$$

where, and X_i and Z_j are arrays of apprentice and occupation/program-specific characteristics, respectively.⁸ The standard estimation method for a fractional dependent variable is to replace it with its log-odds ratio. The obvious drawback of this method is that it requires either the exclusion of observations with the values of zero and unity or their inclusion subject to an ad hoc

⁸ We specify the training supplier as “program-occupation” because in some instances a single program provided training in several different occupations, and each of these occupations could have different standards of curriculum and wage progression in addition to the different occupational characteristics.

transformation. Neither of these solutions is satisfactory since the majority of our observations have either zero or full 8,000 hours of training. We follow Papke and Wooldridge (1996) who proposed an alternative estimator which, unlike the log-odds transformation, does not resort to arbitrary solutions to cope with observations bunched in the corners of the 0-1 interval. The so-called flogit procedure uses quasi-maximum likelihood method to estimate the equation:

$$(2) \quad q_{ij} / 8000 = G\left(\alpha + \sum_i X_i \beta_i + \sum_j Z_j \gamma_j + \varepsilon_{ij}\right),$$

where $G(\cdot)$ is the logistic function. In estimations we clustered observations by program-occupation-year considering that the error terms within these cells would not be independent.

Individual level variables are age and years of education at the time of entry into the program, attendance of trade school, and veteran status. Age is in quadratic specification because while it may serve as a proxy for experience initially, with advancement of age and shortening of the remaining work life, the marginal cost of continuing apprenticeship may eventually exceed the lifetime returns to additional training. Education is the standard pre-existing skills variable. It ranges from nine to sixteen years of schooling,⁹ and is in quadratic form in view of the possible substitutability between training and higher levels of education. Initially we thought that the trade school attendance implied a higher level of pre-existing skills. Perusal of the apprenticeship files revealed that the trade schools are often “skills centers” that require 9th grade reading and 8th grade math, and hold classes in conjunction with the high schools. Thus, it is likely that the trade school provides preparatory programs in specialized training to help youth who face obstacles or demonstrate difficulties in formal education, and trade school attendance may indicate an early deficiency in basic skills. Veteran status may capture pre-existing skills in view of the likelihood

⁹ We entered 16 years for the 26 observations that reported longer years of schooling because our review of registration forms indicated that these figures were not reliable due to the questionnaire format. GED is counted as 12 years of schooling.

that basic skills are acquired in the military. Both trade school and veteran status are binary variables.

Program level variables are the percentages of women and minorities (in respective regressions), the size of the program (in log), program sponsor type, apprentice residence in the Portland metropolitan area, and occupation and industry controls.¹⁰ The shares of women and minorities at the program-occupation level are included to test whether there are observable threshold effects for these groups in training. The size of the program-occupation is introduced to capture economies of scale in the delivery of skills. Both program size and female and minority shares are calculated for the year in which the apprentice started training. The program size is measured as the monthly average of the total number of apprentices registered in a program-occupation, and female and minority shares are calculated as the ratios of each group to the total number of registered apprentices in a program-occupation in a calendar year.

Program sponsorship is a categorical variable – union (base), nonunion and mixed – because, in addition to the union and nonunion programs, Oregon also has “mixed” programs where both union and nonunion employers can be affiliated once they are registered as training program sponsors.¹¹ Oregon also requires all apprenticeship programs to have equal numbers of employer and employee representatives whether the training committee itself is union, nonunion, or mixed, whereas in other states this is true only for the union committees.¹² Thus, the Oregon experience raises the question of whether worker representation in the open shop committees closes the union-nonunion performance gap observed elsewhere in the U.S.

¹⁰ We did not include licensing regulation as a separate control because it is highly collinear with occupational categories which pick-up the effect of licensing.

¹¹ See Oregon Consortium (1996) and Byrd and Weinstein (2005) on the Oregon apprenticeship system.

¹² In nonunion and mixed committees, the State Training Council generally approves any list of employees who are certified as skilled practitioners of the trade and not acting as supervisors.

We estimate equation (2) for each gender and ethnic/racial group (women, men, minority, white) and calculate the expected quantity of training as well as the marginal effects of explanatory variables. These regressions are run first for all apprentices in each group. Secondly, in order to evaluate the quantity of training acquired by the drop-outs, we rerun the regressions for the sub-sample of apprentices who quit.¹³

4. Data

The database includes all new apprentices registered in the Oregon Apprenticeship system from January 1, 1991 to December 31, 2007. We selected the apprentices in programs with 8,000-hour OJT requirements. These are by far the most populous programs accounting for 57 percent of the total 49,468 new registrations. We narrowed observations by selecting apprentices who registered in the ten largest occupations (89 percent of the subtotal) before January 1, 2003 (in order to allow a time period long enough to complete apprenticeship requirements) and did not receive OJT credit for prior experience (in order to make performances comparable). Finally, we excluded apprentices who transferred to other programs or dropped out of the programs for observable “exogenous” reasons (e.g. medical condition, death, program termination), and apprentices who quit within 30 days of indenture (fewer than 200 observations) on grounds that they “effectively” did not start the program. After removing observations with missing or erroneous values, we had a total of 11,031 observations.

<Table 1 here>

Table 1 presents descriptive statistics of the selected sample. Women and minorities constitute 5 and 9 percent of all apprentices, respectively. Women’s representation in apprenticeship is comparable to the figures observed elsewhere, but the minority share is smaller than the nationwide figure. The latter is attributable in part to the smaller relative size of the

¹³ Given the small sample sizes, we did not further distinguish between white and minority women.

minorities in the Oregon labor force (13 percent), and in part to the concentration of minorities in trades that have less than 8,000 hour OJT requirement, which is a characteristic that Oregon shares with the rest of the country.

The average training quantity is two-thirds of the maximum of 8,000. Women and minorities, on average, accumulate substantially smaller number of hours of training in comparison with men and whites: the unadjusted gender and minority training gaps are 18 and 15 percent.¹⁴ The distribution of the completed training hours is strongly bi-polar. As observed in Figures 1 and 2, the majority of apprentices (58 percent) completed apprenticeship training.¹⁵ A substantial minority of apprentices (15 percent) quit with zero hours of credit. Between the extremes of full and no credit, the training hours are mostly in the 0-4,000 hour interval. These patterns remain largely the same by gender and ethnicity, except that completion rates are lower and quit rates are higher for the non-traditional workers.

<Figures 1 and 2 here>

Women are older than men by two years, and average years of schooling do not show much variation across demographic groups. Relatively more women and minorities attended trade school. Women and minorities register in programs that are (on average) larger in size. Access to apprenticeship training for non-traditional workers, especially women, is not uniform by industry or residential location. Women's representation in construction and the Portland area are higher by 10 and 20 percentage points, respectively.¹⁶ Similarly, minorities are also more concentrated in construction and the Portland area by five and 16 percentage points. Electrical

¹⁴ We define the gender training gap as $(\bar{q}_M - \bar{q}_F)/8,000$, where \bar{q}_M and \bar{q}_F stand for average training received by men and women, respectively. The minority training gap is defined similarly.

¹⁵ The completion rate in the Oregon programs is quite high in comparison with the nationwide figure of 40-45 percent.

¹⁶ Most non-construction apprentices are in the manufacturing sector.

and carpentry are the largest trades, jointly accounting for 54 percent of all apprentices. These are also the largest trades for women and minorities.

Only about 10 percent of the apprentices are in the mixed programs with the remainder being divided approximately evenly between union and nonunion programs.¹⁷ The organized sector trains a much larger share of the apprentices than their share of the workforce, as the unionization rate in Oregon was 23 percent over the period (for industries represented in the apprenticeship sample). Women and minority apprentices are represented in relatively higher numbers in the union programs, which is consistent with the national figures (Berik and Bilginsoy, 2002).

5. Estimation Results I: All Apprentices

The estimated marginal effects from equation (2) are reported in Table 2. In order to calculate the training gaps adjusted for control variables, we predicted hours of training for a hypothetical apprentice defined as one who did not attend trade school, is not a veteran, resides outside the Portland metropolitan area, is registered in a construction industry program in a composite occupation (weighted by apprentice shares), and values of continuous variables are at their means.

<Table 2 here>

Since the relative performance of the union and nonunion programs has been of particular interest in previous work, the predicted numbers of training hours in union and nonunion programs are illustrated separately in Figure 3. There are substantial differences by gender, minority status, and sponsor type. In union programs the expected quantity of training for men and women are 5,912 and 4,098 hours, respectively. Men, on average, completed 80 percent of

¹⁷ Many programs reported as mixed were dominated by primarily either union or nonunion apprentices. We re-categorized these cases as either union or nonunion accordingly.

the number of OJT hours required to get certification, while women completed 56 percent. The adjusted training gap is 23 percent. In nonunion programs, the completed training hours are lower by 1,061 for men and 1,280 for women relative to their peers in union programs, and the adjusted training gap is 25 percent. Thus, apprentices on average receive more training in the union programs regardless of gender, but the male-female training gap is only slightly lower in the union programs. Overall, the gender training gap adjusted for correlates is larger than the raw value reported in Table 1. This last result is intriguing in view of the fact that apprenticeship is also employment. The literature suggests that once job and occupation characteristics are controlled for, women's and men's quit rate differentials diminish because women are selected into occupations and jobs that have higher quit propensities (e.g. Blau and Khan, 1981). Our results indicate that women apprentices do not select into program-occupations with lower retention rates in training. They are represented in relatively larger numbers in program-occupations with higher completed training hours.

<Figure 3 here>

The situation is broadly similar for minorities although training gaps are smaller than those by gender. Adjusted white-minority training gaps are seven and eight percent, respectively, in union and nonunion programs.¹⁸ These are substantially lower than the unadjusted gaps, which indicate that minorities select into program occupations with higher attrition rates. Overall, these results are consistent with the findings of previous studies in spite of differences in variable definitions and source data (Berik and Bilginsoy, 2000; Bilginsoy, 2003; 2007).

It must be borne in mind that the union effect estimates may be biased if unobserved attributes of the apprentices are correlated with the union status. The direction of this bias is not

¹⁸ Earlier evidence has also shown that the performance of Hispanics is quite close to that of whites while the white-black differential is wide (Bilginsoy, 2006).

obvious. Anecdotally, union programs have the reputation of being better organized and more committed to training (Oregon Consortium 1996). They also provide better wages and benefits. On the down side, the union dues may make union training unaffordable for a beginning apprentice especially when there is a shortage of jobs. If, on balance, more motivated and capable apprentices choose union(nonunion) programs, then the reported estimate of the union effect would be biased upward(downward).

There is limited information on Oregon apprenticeship applications for the 1991-1995 period, rendering it difficult to discern how competitive the admission process is in the union and nonunion programs. These data do not indicate a sharp difference between the rejection rates of union and nonunion programs (66 percent vs. 59 percent). Mixed programs rejected only 2 percent of the applications. Women and minority workers were more likely to be rejected by 14 percentage points each. In the absence of information on individual attributes of the applicants (e.g. basic skills, education levels), it is difficult to assess relative competitiveness of union and nonunion programs from these figures. As the next step in assessing the selection bias, we identified the 1,788 apprentices with duplicate applications to both union and nonunion programs and examined the chances of an applicant rejected by a union program entering a nonunion program and vice versa. Six percent of these apprentices were rejected by union programs but eventually admitted to a nonunion program; and 5 percent who were rejected by nonunion programs were eventually admitted into a union program. Moreover, 25 percent were rejected by both union and nonunion programs. These findings do not suggest that one type of program takes the cream of the crop first and leaves the lesser qualified apprentices to others, and hence selection bias is probably not a serious problem.

Figures 4 and 5 illustrate the education-training and age-training profiles. The returns to age and education have inverted-U shapes. Age-training profiles of men and whites are relatively flat and virtually identical. In comparison with a base 16-year old, a 35 year old (peak training age) male or white entrant accumulates merely about 520 hours of additional training. Age has a far more prominent effect on women's training than men's. It peaks at the age of 31, and the average difference in the quantity of training of the 16 and 31 year old apprentices is as high as 1,830 hours. The lower level of younger women's training may be an outcome of several factors including: relative lack job market experience, which makes it more difficult to attain training jobs; more household obligations, such as younger kids, that force them to interrupt their training¹⁹; lack of financial resources to arrange transportation and purchase tools; being more likely targets of discriminatory behavior or harassment due to their youth and lack of labor market experience. The age-training profile of the minorities, in contrast, rises by a very small amount until the age of 25 and then declines. This result may indicate that for minorities age is not as good a proxy for labor market experience and prior skills as for other groups, or that the latter factors are not important.

<Figures 4 and 5 here>

The marginal impacts of education for women and minorities are sizeable. The change in the quantity of training from nine and the peak 14 years of schooling is about 2,000 hours for women and 2,600 hours for minorities. The education-training profiles for men and whites are flatter but still substantial, with changes of about 1,700 and 1,500 hours, respectively. It is interesting to note that the peak number of 14 years of schooling corresponds to high school graduation plus a two-year community college associate of arts degree. This may suggest the

¹⁹ Lacking data on marital status and household composition, we cannot further inquire into the impact of unpaid household labor on the quantity of training.

possible complementary roles of general and vocational education for success in apprenticeship. Community college is oriented more toward vocational skill acquisition, so it is expected to supplement apprenticeship training and prepare an entrant for the RTI component of the program. The traditional 4-year academic career path, and the Bachelor's degree, on the other hand, would be expected to either detract from needing the additional apprenticeship credential or provide an avenue to learning more theoretical subjects like engineering rather than preparing for the applied learning that is required in the trades. We do not, however, have data to distinguish between college and community college education and verify this interpretation.

The quantity of training responds negatively to attendance at trade school, and this result is statistically highly significant for all groups, except women. The magnitude of this effect is the largest for the minorities. Minority workers who attended trade school received 1,120 hours less training in comparison with those who did not. In light of the earlier comments on the nature of trade school this outcome suggests that apprentices who attended the trade school were more lacking in basic skills.

The impact of veteran status is both substantial and statistically significant only for women. Women veterans receive more training by about 1,250 hours. This result suggests the positive effects on training of basic skills acquired in the military and, perhaps, the coping skills to endure a male-dominated environment.

Apprentices in industries other than construction (primarily manufacturing) receive more training. The estimated effects are especially large for women (2,280 hours) and minorities (1,920 hours). Given the structural differences between construction and other industries, this is not a surprising result. In the construction industry, employer-employee relationship is much looser than in the manufacturing sector, and workers are in constant flux between contractors and

jobs. In the manufacturing sector apprentices probably have more steady work. In Oregon, most of the manufacturing programs also recruit apprentices for maintenance departments from among their current line employees, which implies a more stable contact between the employer and the apprentice. Working conditions are also likely to be more adverse for women in construction since the constant search for new jobs as the previous one is completed and arranging transportation to changing job sites may be especially burdensome for those who are also more likely to bear greater responsibilities at home.

6. Estimation Results II: Apprentices Who Cancelled

In the U.S., nonunion program sponsors often attribute their lower retention rates to what they consider to be needlessly long apprenticeship training requirements, instruction in skills that are of little use to individual employers, and the ability of their apprentices to find well-paying outside jobs in the trades prior to the completion of training. If these claims are correct, then the higher completion rate in union programs is a suboptimal outcome of perverse incentives created by institutional factors. Namely, union workers are compelled to complete apprenticeship requirements fully in order to receive journey-level certification and qualify for union wage and benefits, whereas nonunion program apprentices, unburdened by the union membership requirements, quit at the optimal hours of training, which is prior to program completion.²⁰

Since we do not have data on post-apprenticeship labor market outcomes, this hypothesis cannot be tested directly by comparing the returns to training. However, it is possible to test several implications of the argument. First, if higher average training hours in union programs are attributable to incentives created by membership requirements, then the observed training gap in favor of the union programs should disappear when completed apprenticeships are

²⁰ Under conditions of asymmetric information, nonunion workers would also have the incentive to get certification to signal worker quality, but the issue is not raised in the debates among the industry observers.

excluded from the sample. Second, the training quantity of nonunion quitters should be sufficiently high so that they can get well-paying high-skill jobs. Third, the male-female and white-minority training gaps among quitters should be higher than those for the whole sample. This follows from the conjecture that the average quantities of training for non-traditional workers in Figure 3 are likely to be directly affected by the need to complete apprenticeship in order to get jobs in the trade. Hence, among the non-traditional quitters the average quantity of training is expected to decline disproportionately relative to men/whites resulting in wider training gaps.

The polarized distribution of the quantity of training illustrated in Figures 1 and 2 also raises concerns about the interpretation of the estimated marginal effects on training hours (reported in Table 2) for the “average” apprentice. While these estimates are useful in the sense that they show the economic and statistical significance of the determinants of training, they may be driven by the completed apprenticeships. If this is indeed the case, then for public policy Table 2 may be useful in identifying the factors that raise the probability of completion of apprenticeship training, rather than determining the necessary tweaks in independent variables to raise the quantity of training incrementally.

In order to assess whether the union advantage is an artifact of union membership incentives and whether the estimated marginal impacts on the quantity of training are driven by the corner observations, we estimated equation (2) for a sub-sample that includes only cancelled apprenticeships.²¹ The marginal effects for the quitters are reported in Table 3. First, nonunion sponsorship still has a negative impact on the quantity of training, although the magnitude of this effect is smaller and statistically marginally significant for minorities and women ($p < 0.10$ and

²¹ We excluded quitters with zero hours of credit as well considering that they arguably were never effectively apprentices.

$p < 0.15$, respectively). Terminated nonunion apprentices receive less training than their union peers, and therefore there is no evidence supporting the argument that the higher predicted union training hours observed in Figure 3 are due to the perverse incentive created by the certification requirement.

<Table 3 here>

Secondly, Figure 6 shows that the average hours of training acquired by the apprentices who cancelled are modest, reaching 40 percent of the required hours for completion for the union minority workers, and ranging from 20 percent to 33 percent for the other groups. Since the first 1,000 hours of training (12.5 percent) is the probationary period during which apprentices perform more menial tasks, it is unlikely that many cancelled apprentices can find outside jobs beyond the semi-skilled level.

<Figure 6 here>

Third, Figure 6 also shows that the gender training gap is smaller among the apprentices who cancelled. The training differential by gender is 650 hours (8 percent gap) in the union sector and 695 hours (9 percent gap) in the nonunion sector. The gap by minority status turns negative, with minority workers receiving more training than whites by as much as 776 hours (-9 percent gap) in the union sector, and 209 hours in the nonunion sector (-3 percent gap). If whites and men quit because they had easier access to outside jobs than the nontraditional workers, these gaps would have increased when completions are excluded.

These three results for the cancelled apprenticeships – persistent negative nonunion effect, low average hours of training and the shrinking training gaps – indicate that quits from apprenticeship are neither the outcome of the ability to acquire sufficient training prior to completion of the program nor the perverse incentives to complete due to the certification

premium. One important caveat concerns the minority workers, however: the higher quantity of training acquired by minority apprentices who quit suggests that they are creating for themselves a particular niche in the semi-skilled workforce.

Finally, Table 3 also shows that some of the results reported in Table 2 are indeed driven by the corner observations. For cancelled apprentices age ceases to be an important factor in determining the quantity of training. The effects of education persist with the inverted U-shapes, but they are modest, both in magnitude and statistical significance, especially for women and minorities. Attendance in trade school, which signals a lack of basic skills, also does not have a statistically significant effect on the quantity of training. These results suggest that experience and skill factors, especially for the nontraditional apprentices, raise average quantity of training because they improve the chances of program completion.

7. Conclusion

This paper used the Oregon apprenticeship data on the incoming apprentices to measure gender and minority training gaps in terms of the number of completed OJT hours. Historically, both groups have been excluded from the craft apprenticeship programs. Women's participation in apprenticeship programs in Oregon, as in the rest of the U.S., remains woefully low. Participation of minorities in apprenticeship is in line with their representation in the Oregon workforce, although in the subset of the occupations considered in this paper – commonly recognized as the more skilled trades – their representation lags behind. In terms of quantities of training, the performances of women and minorities do not match those of their traditional counterparts, although there are some differences between the experiences of women and minorities as well. Controlling for individual, occupational and training program characteristics, men on average receive more training than women by as much as a quarter of the total hours

required to qualify as certified journey worker. The minority gap was substantially smaller at around seven percent. These findings confirm results of previous research that relied, due to data limitations, on more limited measures of apprentice performance. One distinguishing feature of the minority workforce is that on average they receive less training than whites, but there are relatively more of them who quit with relatively more skills. One hypothesis that follows from this observation is that it is more common for minority workers to acquire sufficient skills that enable them to join the semi-skilled workforce.

Among individual characteristics both education and age have inverted-U shaped effects on the quantity of training. The age effect is the strongest for women. The lower training observed for younger women may be the outcome of a combination of factors including their household responsibilities that weaken their attachment to training, the training sponsor's reluctance to allocate resources (including mentoring) to younger women on the grounds that such a weakness exists (actual or perceived), younger women's lack of experience in getting training jobs or coping with a likely hostile work environment. All of these factors, however, point to the need for creation of support networks, ranging from arrangement of childcare and transportation to designing a secure and cooperative worksite. The education effect, on the other hand, is stronger for both women and minorities. These results underscore that better preparation in basic skills, including remedial programs and pre-apprenticeship programs targeting women and minorities, is imperative. In the case of women, there is reason to be skeptical of the effectiveness of these measures albeit they are needed to start chipping away the barriers that hold young women back. In order to remove the enormous obstacles to women's participation in apprenticeship, and ultimately the skilled workforce, radical transformation is needed to change the male-oriented organization, hierarchy, and culture of the trades.

The estimated marginal effects are driven by the completed apprenticeships and therefore are not meant to be used in calculating the necessary changes in the independent variable to achieve a desired change in the quantity of training. They are useful to identify the factors that affect the likelihood of completion and the target of public policy focus on creating the conditions that maximize the completion of apprenticeship training.

The most prominent finding is that union programs deliver more hours of training in comparison with the nonunion and mixed programs, and women and minorities benefit disproportionately more from training in union programs. The evidence does not support the hypothesis that this is the outcome of the early quits in the nonunion sector after acquisition of sufficient skills that secure well-paying jobs. Consequently, the continuing decline in the rate of unionization is problematic not only for the maintenance of a highly skilled workforce, but also for the disproportionately adverse consequences for the integration of women and minorities into the trades.

Table 1: Descriptive Statistics (standard deviations in parentheses)

	All	Men	Women	White	Minority
N	11,031	10,490	541	10,069	962
Earned OJT credit hours	5,304 (3,421)	5,373 (3,402)	3,970 (3,494)	5,412 (3,383)	4,176 (3,602)
Completions (%)	57.7	58.8	37.7	59.2	42.4
Quits (%)	41.4	40.4	60.8	40.0	56.7
Age	29.1 (8.1)	29.0 (8.1)	31.1 (7.4)	29.1 (8.1)	29.1 (7.6)
Education	12.5 (1.3)	12.5 (1.3)	12.9 (1.5)	12.5 (1.3)	12.5 (1.4)
Attended trade school (%)	15.0	14.8	18.9	14.6	19.8
Veteran (%)	15.6	16.2	5.0	16.0	11.9
Program size	155.8 (145.5)	153.9 (145.0)	192.3 (149.8)	153.6 (144.9)	179.6 (148.9)
Portland (%)	39.5	38.6	58.0	38.2	54.0
Construction (%)	85.1	84.5	95.4	84.6	89.6
Union program (%)	44.6	43.8	59.5	43.7	53.7
Nonunion prog. (%)	45.6	46.0	37.2	46.1	40.5
Mixed program (%)	9.9	10.2	3.3	10.3	5.7
Carpenter (%)	20.1	19.6	31.1	19.1	30.7
Comm. Tech. (%)	8.3	8.2	11.7	8.3	9.2
Drywall applicator (%)	2.4	2.4	3.3	2.1	5.6
Electrician (%)	34.1	33.9	39.2	34.7	28.4
HVAC/TR Tech.	2.1	2.2	0.4	2.2	1.1
Maint. electrician (%)	7.5	7.7	3.1	7.7	5.0
Maint. Mechanic (%)	4.9	5.1	0.9	5.1	2.8
Millwright (%)	2.2	2.3	0.9	2.3	1.8
Pipefitter (%)	5.5	5.4	5.9	5.4	5.5
Plumber (%)	12.9	13.3	3.5	13.1	10.0

Source: Oregon Apprenticeship System Database.

Table 2: Estimated Marginal Effects – All Apprentices

	Women	Men	Minority	White
Age	0.063 (3.44)***	0.013 (2.36)**	0.018 (1.30)	0.013 (1.99)**
Age-squared	-0.001 (3.64)***	-1.8E(-4) (2.36)**	-3.5E(-4) (1.68)*	-1.8E(-4) (2.02)**
Education	0.317 (2.43)**	0.178 (3.65)***	0.340 (3.57)***	0.167 (3.48)***
Education-squared	-0.011 (2.34)**	-0.006 (3.21)***	-0.012 (3.24)***	-0.006 (3.07)***
Trade-schooled	-0.053 (0.68)	-0.053 (3.79)***	-0.140 (3.65)***	-0.040 (2.55)**
Veteran	0.157 (2.63)***	-0.003 (0.22)	-0.004 (0.11)	0.005 (0.46)
Nonunion program	-0.160 (3.93)***	-0.132 (7.63)***	-0.146 (2.72)***	-0.134 (7.03)***
Mixed program	-0.046 (0.20)	-0.114 (2.40)**	-0.110 (0.90)	-0.116 (2.40)**
Female share in program	0.004 (0.81)	0.003 (1.58)		
Minority share in program			1.2E(-4) (0.07)	-0.001 (0.73)
Program size	-0.051 (2.12)**	0.018 (2.74)***	0.026 (1.19)	0.017 (2.43)**
Portland	0.015 (0.42)	0.012 (0.78)	-0.074 (2.49)**	0.025 (1.96)*
Non-construction	0.285 (1.72)*	0.138 (3.19)***	0.240 (3.10)***	0.125 (2.82)***
N	541	10,490	962	10,069

Notes: z-values in parentheses. *, **, and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Occupation dummies are included in all regressions.

Base apprentice is defined as a non-veteran union apprentice registered in a program outside the Portland metropolitan area, in the construction industry; continuous variables are at their mean values and the values of occupation dummies are set at their shares of incoming apprentices. Marginal changes are calculated for one-year changes in age and education, and percentage point changes in female and minority shares, and program size.

Table 3: Estimated Marginal Effects –Apprentices Who Cancelled

	Women	Men	Minority	White
Age	0.025 (1.62)	0.003 (1.62)	0.022 (1.36)	0.002 (0.36)
Age-squared	-3.9E(-4) (1.56)	-1.8E(-5) (0.00)	-4.2E(-4) (1.74)*	-5.0E(-6) (0.07)
Education	0.099 (1.67)*	0.066 (0.03)**	0.141 (1.35)	0.052 (1.88)*
Education-squared	-0.004 (1.70)*	-0.003 (0.00)**	-0.005 (1.28)	-0.002 (2.00)**
Trade schooled	-0.056 (1.48)	-0.008 (0.01)	-0.031 (0.74)	-0.005 (0.32)
Veteran	-0.034 (0.53)	-0.008 (0.01)	-0.033 (0.76)	-0.001 (0.13)
Nonunion program	-0.046 (1.44)	-0.040 (0.01)***	-0.096 (1.67)*	-0.032 (2.45)**
Mixed program	-0.144 (3.84)***	0.002 (0.03)	0.208 (1.17)	-0.021 (0.65)
Female share in program	0.006 (1.79)*	-2.8E(-4) (0.00)		
Minority share in program			-2.8E(-4) (0.10)	-0.002 (1.34)
Program size	-0.017 (0.77)	0.008 (0.01)	-0.006 (0.35)	0.009 (1.09)
Portland	0.025 (0.71)	0.001 (0.01)	-0.079 (2.78)**	0.012 (1.05)
Non-construction	0.667 (17.71)***	0.128 (0.06)**	-0.117 (1.04)	0.162 (2.84)***
N	215	2,657	308	2,564

Notes: The sample includes only quits with non-zero hours of OJT credit.
See also notes to Table 2.

Figure 1: Distribution of Training Hours by Gender

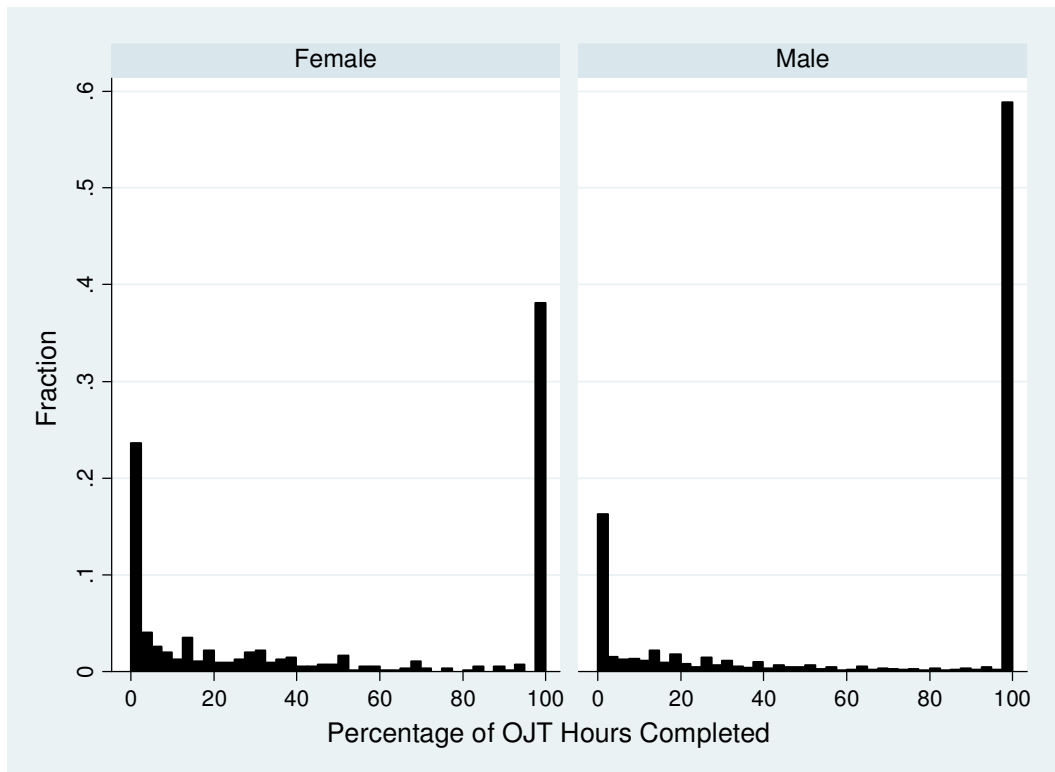


Figure 2: Distribution of Training Hours by Minority Status

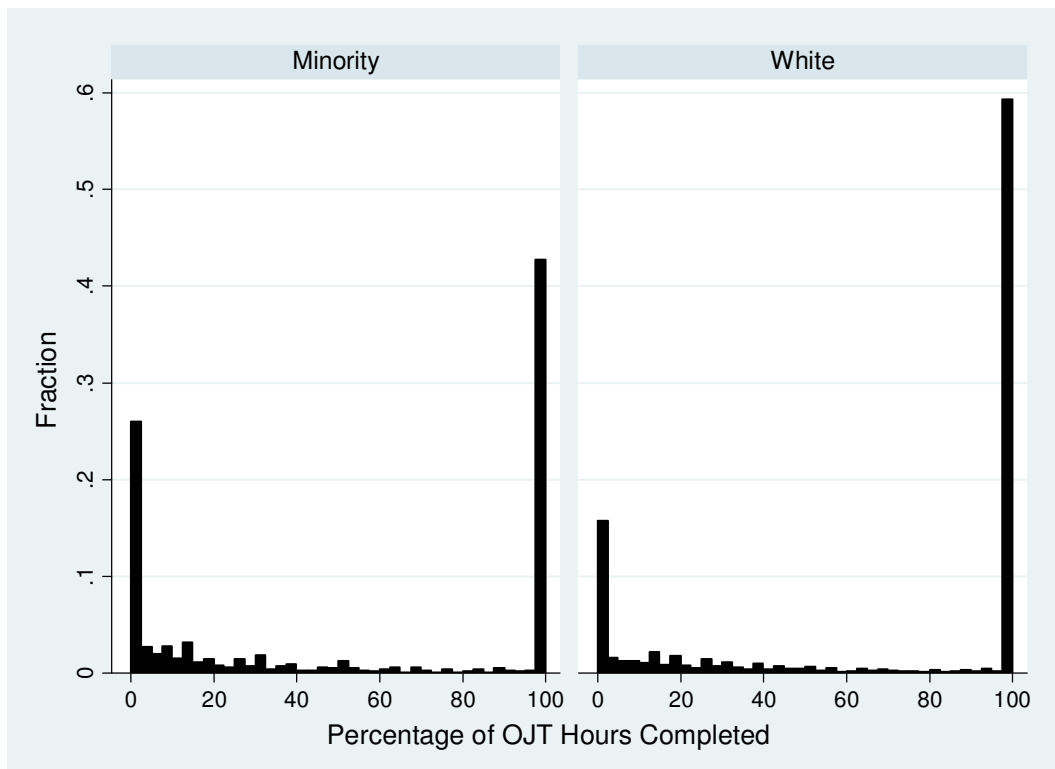


Figure 3: Predicted Hours of OJT Training – All Apprentices

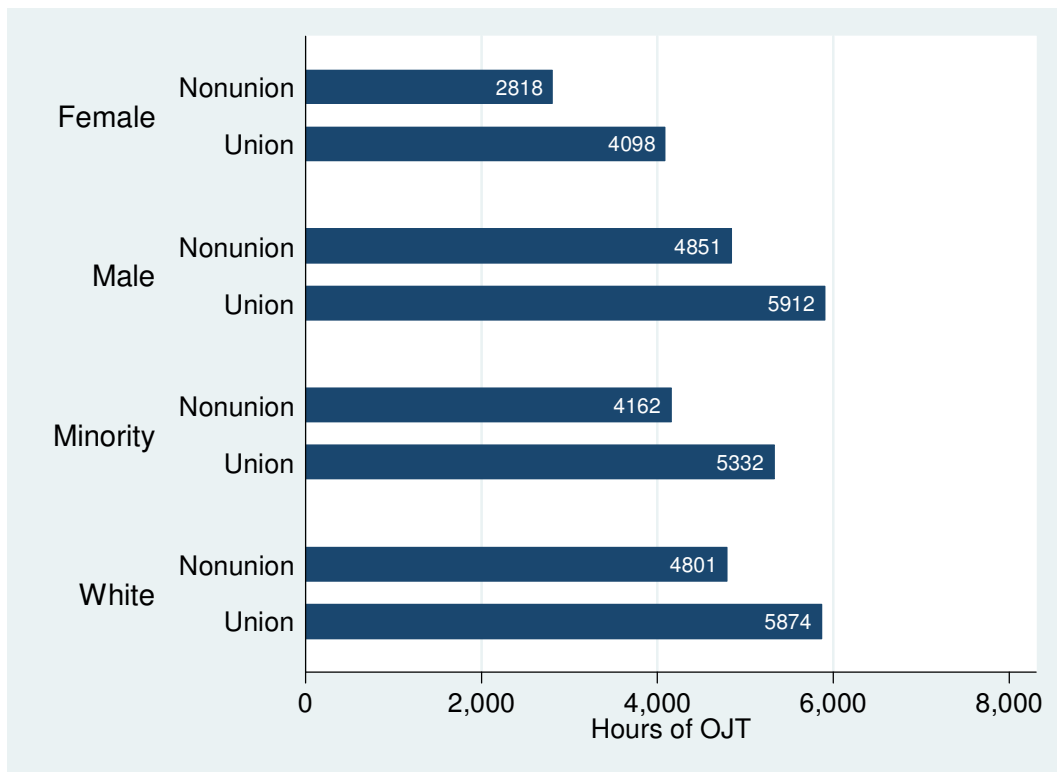


Figure 4: Age-Training Profile

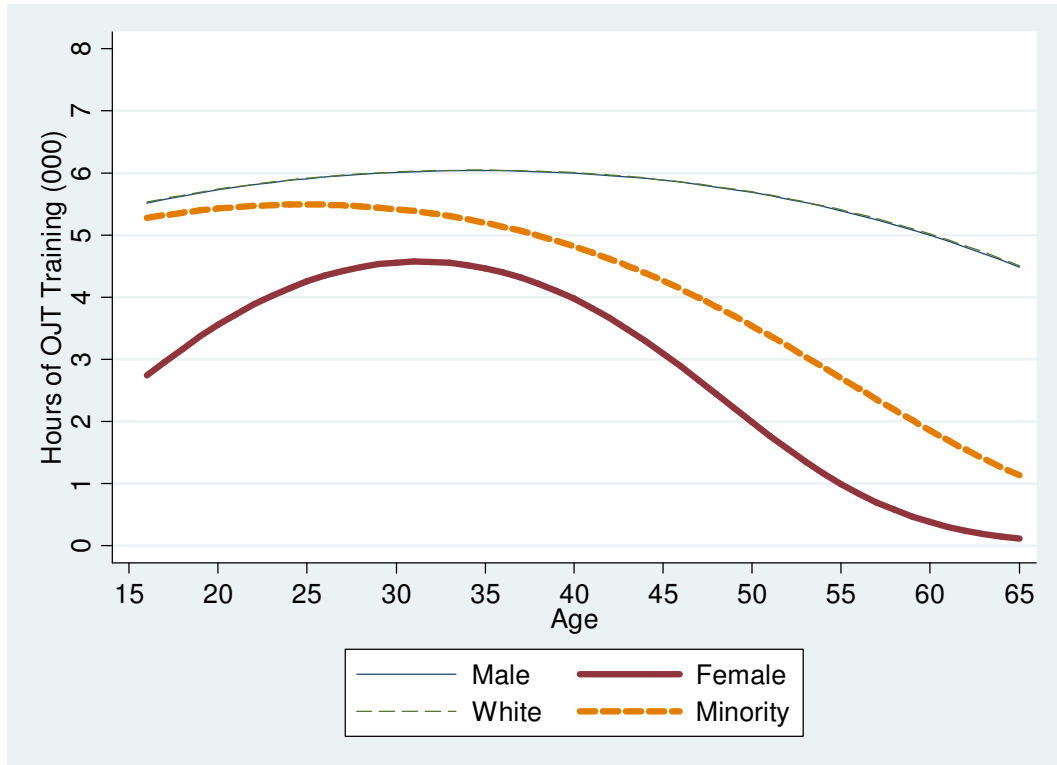


Figure 5: Education-Training Profile

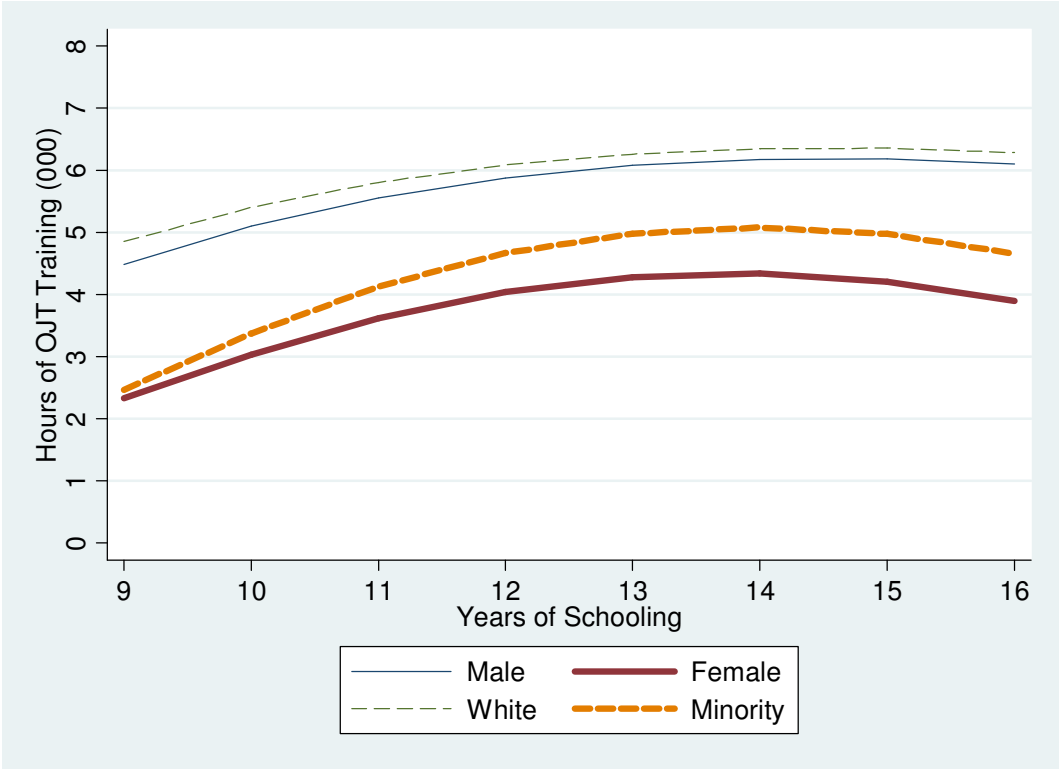
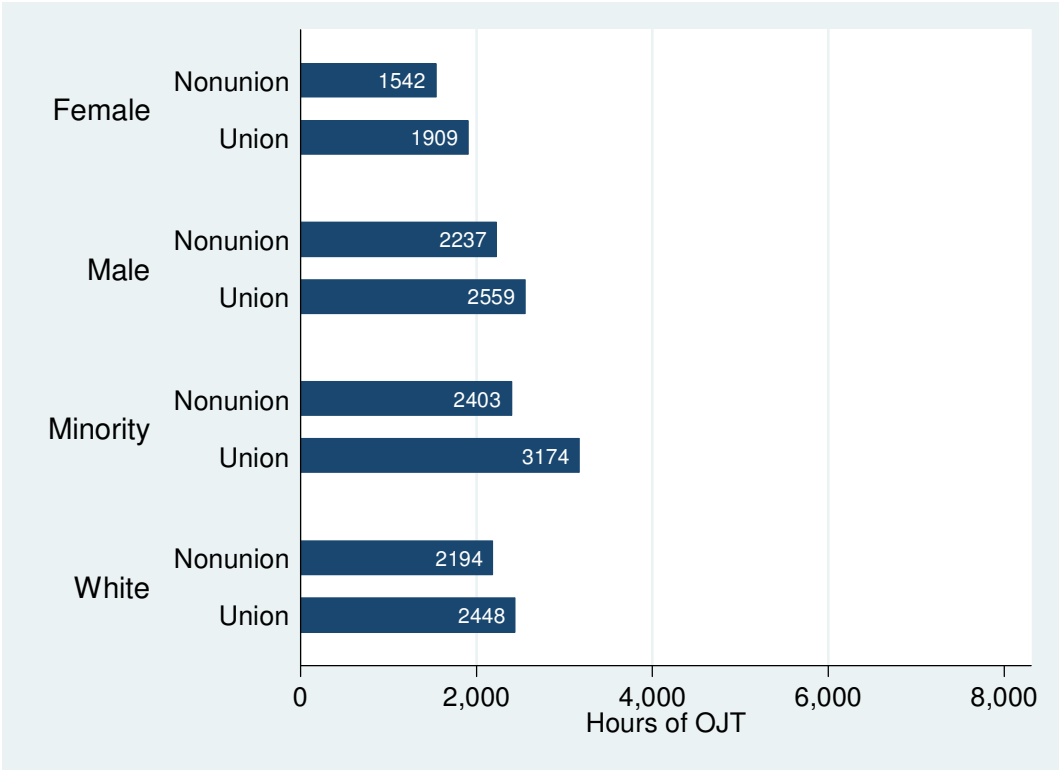


Figure 6: Predicted Hours of OJT Training –Apprentices Who Cancelled



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